REMARKS

Claims 1-14, 17-33, 35-48 and 51-56 are pending in this application. Claims 1, 21 and 40 have been amended. Claims 15, 16, 34, 49 and 50 have been canceled and their subject matter has been incorporated in amended independent claims 1, 21 and 40. No new matter has been introduced.

Claims 1-8, 11, 13, 14, 17-24, 27, 29-33, 35-43, 46, 48 and 51-56 stand rejected under 35 U.S.C. § 103 as being unpatentable over Wang et al. (U.S. Patent No. 5,607,874) ("Wang") in view of Mizuhara et al. (U.S. Patent No. 6,228,438 B1) ("Mizuhara"). This rejection is respectfully traversed.

The claimed invention relates to a method of forming a composite barrier layer between a glass insulating layer and active regions of a memory device. As such, amended independent claim 1 recites a "method of forming a composite insulating structure" by *inter alia* "forming an oxide layer over said source/drain region, said oxide layer having a thickness of about 50 Angstroms to about 100 Angstroms and being formed by oxidizing approximately an upper surface of said source/drain region using atomic oxygen." Amended independent claim 1 also recites "forming a barrier layer in contact with said oxide layer."

Amended independent claim 21 recites a "method for forming a memory cell" by *inter alia* "forming a composite barrier layer over said source/drain regions, said composite barrier layer comprising an oxide layer formed by oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen, and a barrier layer formed over said oxide layer, said barrier layer having a thickness of about 30 Angstroms to about 150 Angstroms." Amended independent claim 21 also recites "forming a glass insulating layer in contact with said composite barrier layer."

Amended independent claim 40 recites a "method of preventing the diffusion of atoms from a glass insulating layer in to a source/drain region formed between adjacent

gate stacks of a memory device" by *inter alia* "forming a composite barrier layer over said source/drain region . . . said composite barrier layer comprising an oxide layer formed to a thickness of about 50 Angstroms to about 100 Angstroms by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen." Amended independent claim 40 further recites "a barrier layer formed over said oxide layer."

Wang relates to "a method for fabricating a T or Y shaped capacitor which has less photolithographic and etch steps than the conventional processes." (Col. 2, lines 28-31). For this, Wang teaches the formation of several gate stacks over a substrate and of a source and drain region. (Col. 4). Wang also teaches the formation of an oxide layer (col. 5, lines 11-17) and of a barrier layer over source/drain regions. (Col. 5, lines 29-35).

Mizuhara relates to "a semiconductor device that allows the adhesion intensity between an upper insulation film and a lower insulation film to be improved." (Col. 2, lines 31-34). Mizuhara teaches the formation of "a silicon oxide film 21 by CVD all over the device," which is a completed MOS transistor. (Col. 4, lines 50-53). Mizuhara then teaches forming an aluminum alloy film over the film 21, forming another silicon oxide film 5 over the aluminum alloy film, forming an organic SOG film on the silicon oxide film 5, and forming another silicon oxide film 8 on the SOG film. (Col. 4, lines 61-67; Col. 5, lines 1-49). According to Mizuhara, the silicon oxide films 5 and 8 can be formed by a number of CVD methods using the reactant gases monosilane and oxygen or TEOS and oxygen. (Col. 4, lines 61-67; Col. 12, lines 51-61).

The subject matter of claims 1-8, 11, 13, 14, 17-24, 27, 29-33, 35-43, 46, 48 and 51-56 would not have been obvious over Wang in view of Mizuhara. Specifically, the Office Action fails to establish a *prima facie* case of obviousness. Courts have generally recognized that a showing of a *prima facie* case of obviousness necessitates three requirements: (i) some suggestion or motivation, either in the references themselves or in the knowledge of a person of ordinary skill in the art, to modify the reference or combine the reference teachings; (ii) a reasonable expectation of success; and (iii) the prior art

references must teach or suggest all claim limitations. See e.g., In re Dembiczak, 175 F.3d 994 (Fed. Cir. 1999); In re Rouffet, 149 F.3d 1350, 1355 (Fed. Cir. 1998); Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573 (Fed. Cir. 1996).

First, neither Wang nor Mizuhara, whether considered alone or in combination, teach or suggest all limitations of amended independent claims 1, 21 and 40. Neither Wang nor Mizuhara teaches or suggests "forming an oxide layer . . . having a thickness of about 50 Angstroms to about 100 Angstroms . . . by oxidizing an upper surface of said source/drain region using atomic oxygen," as amended independent claim 1 recites. Wang and Mizuhara also fail to teach or suggest "forming a composite barrier layer . . . comprising an oxide layer formed to a thickness of about 50 Angstroms to about 100 Angstroms by oxidizing approximately an entire upper surface of said source/drain region using atomic oxygen," as amended independent claim 40 recites.

As acknowledged by the Office Action dated May 2, 2003, Wang is silent about forming an oxide layer by oxidizing an upper surface of a source/drain region using atomic oxygen, much less about forming an oxide layer "having a thickness of about 50 Angstroms to about 100 Angstroms" by oxidizing approximately an upper surface of a source/drain region using atomic oxygen, as in the claimed invention. (Office Action at 3). In fact, Wang teaches that conformal insulating layer 22, which would arguably correspond to the oxide layer of the claimed invention, has a thickness "in the range between about 500 and 3000 Å" (col. 5, lines 15-17), and not "of about 50 Angstroms to about 100 Angstroms," as in the claimed invention.

Mizuhara also fails to teach or suggest all limitations of amended independent claim 1. In Mizuhara, silicon oxide film 21, which would arguably correspond to the oxide layer of the claimed invention, is formed "all over the device" and not to a minimal thickness "of about 50 Angstroms to about 100 Angstroms," as in the claimed invention. Mizuhara also teaches *depositing* silicon oxide films 5 and 8 on an aluminum alloy film or an organic SOG film, respectively, by plasma CVD or atmospheric CVD, and not by

oxidizing upper surfaces of a source/drain region using atomic oxygen, as in the claimed invention. For plasma CVD, Mizuhara teaches using the reactant gases monosilane and oxygen or TEOS and oxygen, while for atmospheric CVD, Mizuhara teaches using monosilane and oxygen. (Col. 4, lines 61-67; Col. 5, lines 1-49; Col. 5; Figs. 2-4). Accordingly, Mizuhara does not teach or suggest forming an oxide layer of a particular thickness. Mizuhara also does not teach or suggest forming an oxide layer, much less forming an oxide layer of a particular thickness, by oxidizing upper surfaces of a source/drain region using atomic oxygen.

Wang and Mizuhara, whether considered alone or in combination, also fails to teach or suggest all limitations of amended independent claim 21. Wang and Mizuhara fail to teach or suggest forming "a composite barrier layer over said source/drain regions . . . comprising an oxide layer formed by oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen, and a barrier layer formed over said oxide layer, said barrier layer having a thickness of about 30 Angstroms to about 150 Angstroms," as amended independent claim 21 recites. Wang teaches that etch barrier layer 24, which would arguably correspond to the barrier layer of the claimed invention, has a thickness "in the range between about 500 and 3000 Å" (col. 5, lines 32-34), and not "of about 30 Angstroms to about 150 Angstroms," as recited in amended independent claim 21. Similarly, Mizuhara teaches that silicon oxide film 5, which would arguably correspond to the barrier layer of the claimed invention, is of "approximately 500 nm in thickness" (or about 5000 Å) (col. 4, lines 61-62), and not "of about 30 Angstroms to about 150 Angstroms," as in the claimed invention.

Second, the assertion of the Office Action dated May 2, 2003 that for plasma CVD "[o]xygen and a silane gas are entered into a chamber and are converted into a plasma, which gives out atomic oxygen" is unsupported. (Office Action at 8). From this assertion, the Office Action concludes that that "[i]t would be reasonable to assume that at some point the atomic oxygen would react with the surface of the source/drain region and, to some extent, form an oxide layer on the source/drain region." (Office Action at

8). It would not be reasonable, however, to assume that the CVD process of Mizuhara would achieve oxidizing approximately an entire upper surface of a source/drain region. Mizuhara provides no teaching or suggestion of oxidizing any portion of an upper surface of a source/drain region. As noted above, Mizuhara only teaches depositing silicon oxide films 5 and 8 on an aluminum alloy film or an organic SOG film, respectively, by plasma CVD using monosilane and oxygen or TEOS and oxygen. In the CVD process of Mizuhara, independent sources of silicon, TEOS or monosilane, are provided as reactants. As a result of the CVD process, a silicon oxide layer is deposited over an aluminum alloy film or an organic SOG film. In contrast, the methods recited by amended independent claims 21 and 40 include oxidizing approximately an entire upper surface of a source/drain region, such that the upper surface of the source/drain region serves as a reactant.

Third, the application by the Office Action of the inherency doctrine to establish a *prima facie* case of obviousness is also deficient. Inherency is a doctrine applicable to rejections under 35 U.S.C. § 102 and is not a substitute for the elements necessary to establish a *prima facie* case of obviousness. See M.P.E.P. § 706.02; see also In re Bond, 910 F.2d 831 (Fed. Cir. 1990). "[W]hen the PTO asserts that there is an explicit or implicit teaching or suggestion in the prior art, it must indicate where such a teaching or suggestion appears in the reference. . . . The mere fact that a certain thing may result from a given set of circumstances is not sufficient [to establish inherency] . . . . 'That which may be inherent is not necessarily known. Obviousness cannot be predicated on what is unknown.'" In re Rijckaert, 9 F.3d 1531, 1534 (Fed. Cir. 1993) (emphasis added).

The Office Action fails to support its assumption with a reference to cited prior art. Moreover, the Office Action has not alleged or shown that the assumed process is instructional to those skilled in the art. In short, the case of obviousness is also deficient in its failure to demonstrate that those skilled in the art would have taken any useful teaching or suggestion, or would have been motivated to provide the present invention based on any of the cited references. Even assuming that the inherency doctrine is applicable to this 35 U.S.C. § 103(a) rejection, the Office Action has not established that the assumed

process is inherent. For at least these reasons withdrawal of the rejection of claims 1-8, 11, 13, 14, 17-24, 27, 29-33, 35-43, 46, 48 and 51-56 is respectfully requested.

Claims 9, 25, and 44 stand rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Mizuhara as applied to claims 1-8, 11, 13, 14, 17-24, 27, 29-33, 35-43, 46, 48 and 51-56 above, and further in view of Lands et al. ("Lands") (U.S. Patent No. 3,571,914). This rejection is respectfully traversed.

Lands relates to a "method for stabilizing a semiconductor device against spuriously induced changes in the conductivity characteristics at the surface of the semiconductor." (Col. 1, lines 58-61). The crux of Lands is the use of a silicon dioxide layer formed by the oxidative decomposition of TEOS, by the pyrolysis of TEOS in an inert atmosphere, by the hydrogen reduction of silanes, or by other similar processes wherein the oxide layer may be uniformly doped by the desired stabilizing agent during formation of the oxide layer and stabilization of the surface of a semiconductor device." (Col. 3, lines 27-34).

As noted above, neither Wang nor Mizuhara, whether considered alone or in combination, teach or suggest all limitations of amended independent claims 1, 21 and 40. Similarly, Lands fails to teach or suggest forming an oxide layer "having a thickness of about 50 Angstroms to about 100 Angstroms", much less forming an oxide layer "having a thickness of about 50 Angstroms to about 100 Angstroms" by oxidizing an upper surface of a source/drain region using atomic oxygen, as amended independent claims 1 and 40 recite. Lands also fails to teach or suggest "forming a composite barrier layer over said source/drain regions, said composite barrier layer comprising an oxide layer formed by oxidizing approximately entire upper surfaces of said source/drain regions using atomic oxygen, and a barrier layer formed over said oxide layer, said barrier layer having a thickness of about 30 Angstroms to about 150 Angstroms," as amended independent claim 21 recites. For at least these reasons, the Office Action fails to establish a *prima facie*

case of obviousness, and withdrawal of the rejection of claims 9, 25 and 44 is respectfully requested.

Claims 12, 28, and 47 stand rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Mizuhara as applied to claims 1-8, 11, 13, 14, 17-24, 27, 29-33, 35-43, 46, 48 and 51-56 above, and further in view of Kirimura et al. ("Kirimura") (U.S. Patent No. 6,383,869 B1). This rejection is respectfully traversed.

Kirimura relates to "a thin film forming method and a thin film forming apparatus, in which a deposition gas and a radical material having different dissociation energies are used for forming a thin film." (Col. 2, lines 46-49).

None of Wang, Mizuhara and Kirimura, whether considered alone or in combination, teaches or suggests all limitations of amended independent claims 1, 21 and 40. Claims 12, 28, and 47 are allowable for at least the reasons stated above for claims 1, 21 and 40, respectively. Therefore, withdrawal of the rejection of claims 12, 28, and 47 is respectfully requested.

Claims 10, 26, and 45 stand rejected under 35 U.S.C. § 103 as being unpatentable over Wang in view of Mizuhara as applied to claims 1-8, 11, 13, 14, 17-24, 27, 29-33, 35-43, 46, 48 and 51-56 above, and further in view of Asahina et al. ("Asahina") (U.S. Patent No. 6,326,287 B1). This rejection is respectfully traversed.

Asahina relates to a method for forming a "semiconductor device using, as a wiring material, a specific aluminum alloy which can be embedded in a through-hole without producing any void or wire breaking, and being highly resistant to electro-migration." (Col. 1, lines 37-41).

None of Wang, Mizuhara and Asahina, whether considered alone or in combination, teaches or suggests all limitations of amended independent claims 1, 21 and 40. Claims 10, 26, and 45 are allowable for at least the reasons stated above for claims 1,

21 and 40, respectively. Therefore, withdrawal of the rejection of claims 10, 26, and 45 is respectfully requested.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

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